SCIENCE

FRIDAY, AUGUST 1, 1913

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THE GOOD ENGINEERING TEACHER, HIS PERSONALITY AND TRAINING[1]

AT the meeting of Section E on Engineering Education of the World's Engineering Congress which was held in Chicago in 1893 in connection with the World's Columbian Exposition, there were assembled "seventy or more" engineering educators from the United States and eight or more foreign countries. This society owes its existence to the congress and to the thought and labors of Professor Ira O. Baker, chairman of the Division Committee, and Professor C. Frank Allen, its secretary *pro tem.* Of the seventy charter members, twenty-nine have either gone to their reward or have withdrawn from the society. Only forty-one of the seventy are now members of the society. Eleven of the living past-presidents are charter members, three became members in 1894, and one each in 1895, 1897 and 1902. That was twenty years ago. Some of us are no longer boys, even if we do feel as young and as full of enthusiasm as we did then. If time and your patience permitted it, and I were able, it would delight me to recall in great detail the lives and examples of some of the giants in engineering education whose successors we are—of the cultured Thurston, of that dynamic giant, DeVolson Wood, of that inventive genius, Robinson, of the courtly Chanute, of the erudite Johnson, and of the versatile Storm Bull. I offer you my congratulations on being allowed to follow where they have led the way.

But after twenty years of this society's

[1] Address of the President of the Society for the Promotion of Engineering Education.

existence for the promotion of engineering education, at this its twenty-first meeting, when our growth betokens that we have come to our legal majority, at least in years, I desire to lead your minds into the consideration of what is a good engineering teacher and to give you an appreciation of his personality, and what he is as I have seen him in three score and more of engineering colleges and technical schools.

What then is a good teacher? And my first answer is that he is one who knows enough of his subject to have something to impart. I sometimes think the reason men from the highest ranks of consulting engineers so frequently make poor teachers, from the point of view of the students, is that they know too much, and can not appreciate the fact that the students are down in the basement of the structure whose façade they are embellishing with artistic points of elegance and efficiency, and that the students are crawling on hands and knees along the path they are traveling with seven-league boots. In order that the teacher shall have something to impart, he should have had a proper education and some training, experience, travel and observation, as these are among the necessary qualifications for a good teacher. The man who has never earned his daily bread in the close commercial competition of the factory, works or mine, needs to learn one of the essential requirements of the successful engineering teacher, namely, to have rubbed elbows with workingmen of the artisan type and to have measured himself by their standards of knowledge and skill. One who has received only the education that he is trying to impart, possibly at his alma mater, probably in the same room in which he received it, who has never cut himself loose from his college's apron strings, and who has not taught or worked elsewhere, is not likely to make a good teacher until he has been trained in the school of experience elsewhere. If graduate students should migrate for their best good, surely college teachers should do the same. In a previous paper before this society I have already referred to one institution, almost one hundred per cent. of whose teachers in one department are the educational offspring of the great mind which presided over the department for thirty years. Experience of any kind always serves a teacher well, and the more he has had of that which pertains to the subject that he is teaching, the better it will be for him and his students. Travel and inspection trips, to learn by observation how others are doing the same thing that he is expected to do, are extremely broadening and take him out of his natural groove. It is needless to say that continued reading and increase in one's knowledge of his profession is absolutely essential for the advancement of the good teacher.

A good teacher is one who can talk on his feet audibly enough to be heard without effort and intelligently enough to be understood without subsequent correction. For, if the listener can not hear what is being said for his instruction, both parties are wasting time which is more or less valuable. If the recipient of the instruction continuously fails to get an intelligent understanding of what has been said, he has no right to be in attendance; and, similarly, if the teacher continuously fails to give an intelligent understanding of what he is trying to say, he should be removed and not allowed to waste the valuable time of the students. A man who can not impart his knowledge can not be a good teacher. Hence, health, adequate previous rest and endurance are essential to the good teacher. Few of us, I think, appreciate the difference in the instruction given and taken in September and in May, on Monday and on

Friday, after a holiday spent in restful occupation and amusements and after an entertainment lasting until far past midnight. Some of us occasionally fail to consider and measure accurately the cash value of an hour of a class's time. We should be greatly disturbed if in our factory the power were needlessly shut off during the working hours of the day, or the lights went out at night, or the subsistence department failed to provide suitable food and lodging for our workmen, and we would at once discover the causes for this industrial inefficiency; but if the class is made to wait while a visitor or an assistant detains us, we may have little remorse, or indeed thought, concerning our academic inefficiency. To attend an engineering college it costs a student at least one dollar per week per credit hour of college work, or from sixteen to twenty dollars per week. If, therefore, the teacher in a college of engineering is absent without a substitute from a one-hour class-room engagement, it may be causing each of the ten to two hundred students to spend a dollar in needlessly trying to fulfil his part of the contract with the institution. The same is true of inexcusable latenesses.

A good teacher is one who has an unimpeached and deserved reputation for mental honesty, right living, patience under harassment and sound character. The engineering teacher who describes tricks of the trade, petty dishonesties, evasions of both the spirit and the letter of the law, without showing at least his disapproval of them, who shuts his eyes to dishonesties in class-room and college life, is neither a good teacher nor yet a good citizen. The teacher who is a leader in trickery, deceit and bluff during the term and who permits students to sit in an examination room so close together as to be under constant temptation to undesired dishonesty is *particeps criminis* to any dereliction of the student then, and possibly later. When cheating in examinations is made a *sine qua non* for honor and high grades, if not for graduation, and when the most skillful compiler of invisible ponies and the most successful cheater becomes the honor man of the class, as I have heard reported in recent trips among the colleges, it would seem that an old-fashioned course in moral philosophy and ethics should be in order for both the teachers and the students. We all fail, I fear, frequently enough, but we should not be forced, or allowed, to fail inordinately. Occasionally we hear condonation expressed at the human frailties of the teacher, because he is considered as a genius in his specialty, and on account of his lovable qualities. Far be it from me to cast stones at my brother man, but I have never been able to discover a reason why a drunkard, or a libertine, should be tolerated in the teaching profession and frowned out of society in other professions and not allowed to work where the physical well-being of others was involved. Surely the mental and the spiritual well-being of our young men are paramount to their physical existence.

The one moral trait which seems to be most frequently demanded above all others from the teacher is that of patience. Some of us do not enjoy walking with persons who walk slowly or with very short steps, and who take a long time to get over very little ground. Similarly, we have to go equally slowly in expounding a new problem to a class, or in drawing out of even the average student the principle underlying the problem in hand, and in causing him to think about the subject consecutively and logically. We have all asked ourselves at the end of the hour, "How many in that class really took in the full significance of what I was talking about?"

If this is true with the average class, how much more is it so with those members who are lazy or are naturally slow in their mental operations?

From the above it follows as a matter of course that the good teacher should deserve the respect of his students and his colleagues as a man, as a teacher and as an engineer. I think it frequently happens that the students know our failings and our strong points better than we do ourselves, or than they are known by our superiors. Student criticism may sometimes be unjust for want of full and complete information, but it must be remembered that the young human mind is likely to be as keen in its perceptions as is the older mind of the man who occupies the other end of the room.

Another requisite in the good teacher is unbounded enthusiasm for and intense loyalty to the work of the teacher and of the engineer. We can tolerate the hireling in the commercial office and the drafting room, and the time-server may have to be put up with out on the works and in the mine, but the teacher, as a leader of young men and as a man who should be looked up to with some degree of that kind of respect which may grow into veneration should be so bubbling over with enthusiasm that it will be contagious.

That prince of cultured scientists, Dr. S. Weir Mitchell, in giving at the semi-centennial celebration of the foundation of the National Academy of Sciences some of his recollections of the eminent men of science whom he had known, told the story of Professor Joseph Leidy's being asked "if he never got tired of life." "Tired!" he said, "Not so long as there is an undescribed intestinal worm, or the riddle of a fossil bone or a rhizopod new to me." So, the enthusiastic teacher is never tired, so long as there is an intelligent boy to be trained or a mind to be developed. The engineer sets in motion the wheels of thousands of machines; the successful educator sets in motion the wheels of a thousand minds. Such a man can always get the work out of his students, even if they have to curtail the time properly due to some other instructor who is less inspiring. The enthusiastic teacher never counts the cost to himself of his labor for those whom he loves to call "his boys."

I am of the opinion that our engineering colleges are less handicapped than are the academic colleges by the services of men who are teaching for a year or two either while studying for the bar or for holy orders, or to enable them to repay the debts contracted for their college education by the means which will permit the least effort during the shortest time. As a rule, the call to work in the bustle of the manufacturing and constructive world is preeminent in the mind of the engineering graduate. He is ready for the fray, and to-day he wants to get into it as never before, and no waiting until cooler weather or until after a summer vacation for him. "I am going to work next Monday," is his battle cry on commencement day. The courage of youth is beautiful to behold, and his zeal is a lesson to his teachers and to those who are following him.

Akin to enthusiasm for his work in the good teacher is his inspirational value to his students and his colleagues in the faculty. The former is the child of youth; the latter is the product of age and genius. When the teacher begins to lose his enthusiasm, he should begin to think that possibly he may be getting old, or else lazy. Not infrequently, however, the teacher who is devoid of enthusiasm may be of great inspirational value. He is the seer. He may be even halting in his speech, but by his ideas, his skill, or his manner of presenting the subject he may impress the stu-

dent with the greatness of the profession that he is studying and lead him on to larger visions. Fortunately, the world needs both draft horses and speed horses, otherwise some of them would have to be put out of the way. Similarly, it is a great comfort to some of us to think that possibly we are doing the work of the world for which we are created, even if we are not breathing out great ideas at every breath. All hail to the man, however, who has ideas and can cause others to adopt them, to lift the world up and into larger visions, and so to do bigger things for the benefit of mankind. Great men are not necessarily either enthusiastic or yet inspirational, and some of the poorest teachers under whom I have sat were great men in other lines of human endeavor. But I am sure we can all recall some one of our own teachers who was both a great man and a good teacher at the same time. But, may I not ask, was he not a good teacher because he was enthusiastic and inspirational, and had no thought of apologizing for being a teacher? The man who can never be a good teacher is he who is ashamed of his job, for to him it is most likely to be only the line of least effort to the pay-check.

The good teacher is he who has felt the thrill of having been called to the upbuilding of character in others, who day by day sees the unfolding of the innermost life of his fellow citizen, who has a life of service to live and enjoy, and who deals with human minds in the laboratory of life; for, after all, is not education only scientific research applied to character? Just as we go to the physician for improvement of the body, and to the priest for the betterment of the human soul, so we should go to the good teacher for the training in character which the young all need in different degrees. One of the inspiring sights of the college year and the one which always gives me a genuine thrill of happiness is on commencement day to look over the sea of upturned faces of men and women who have just been graduated and feel that we have been in some small degree a party to their training and responsible for their future success in the battle of life and in the part that they will hereafter play, for weal or for woe, as our fellow citizens in this republic. In their promise of success is our joy and reward for a year of hard work. But for the joy of service, some of us would not be willing parties to what the governor of Ohio recently described as "the scandal of low salaries paid to college professors." I sometimes think that school boards and trustees occasionally take advantage of the idealism of the teacher to get his services below the proper market rate; and this is especially true of engineering teachers who in most cases can, and sometimes do, earn more money from their clients during a part of the year than they receive from their professorship during the major portion of the year. All the pay of the good teacher does not come inside the pay envelope. Much of it comes in that inward consciousness of work well done in the training for citizenship, for that efficiency which will prevent poverty, for success in whatever walk of life may be followed, and finally for the larger life here and hereafter. Some one has defined the professional class as the one that has no leisure, as instanced by the minister, the physician and the lawyer. Judged by that standard, we, as teachers, belong to the professional class.

Probably some of you have been wondering why I have not as yet said anything about the good engineering teacher being above all other things a good engineer. That goes almost without saying in this presence, provided you mean the *best* teacher. The engineering teacher who has

never practised anything that he has taught, who has never seen built anything that he has designed, who has never prepared for an elaborate test of some plant or machine and found that he had foreseen all the various requirements in the way of labor, apparatus and equipment, even to the board and lodging of himself and his assistants, can not expect to be considered as yet a really good engineering teacher. However, it must be remembered that as this is an educational society, and not an engineering or a technical society, as Dean Charles H. Benjamin has so aptly put it, so it must be remembered that the colleges need men who to be teachers must be first able to impart their knowledge, draw out from their students all that is in them, and cultivate in them the habits of correct thinking, clear vision, active imagination, sound reasoning powers, and good judgment; and because they possess these things themselves and can train others in them, they are therefore fit to be counted among the good teachers. It is for these reasons that good engineering teachers are said to be more difficult to find than are good teachers of other subjects.

A good engineering teacher must know what engineering really is. He must have clearly defined ideas on what are the distinguishing features of engineering, technical, manual training, trade school and industrial educations. He must have no half-hearted ideas as to where the engineering trades stop and where the profession begins. He must not be afraid to get out into the deep water of the profession of engineering. He must not believe that the proper engineering education is strictly utilitarian and vocational, and not one bit cultural. He must look between the folds of the ancient armor of his colleague in the college of arts of his institution, and discover that the scientific spirit has largely superseded the literary spirit even in such subjects as Latin, Greek and the modern languages; that in fact in the work of some language teachers there is more of science than of language; that the so-called literary colleges are training men for vocations just as truly as are our colleges of engineering, law and medicine; that while the old-time classical colleges used to train men to be gentlemen, their successors in the educational world train men for journalism, insurance, politics, trade and business, as well as for education, the law and the ministry as heretofore. We engineers think that they are to be congratulated, in that they have enlarged their system of education and no longer make it so general as to fit the student for nothing in particular and so non-technical as to be useless except as a preparation for one of the professions.

"To know the best that has been thought and said in the world" is what Matthew Arnold calls culture. To the engineer, this is not the fullness of culture, but the rather to know the best that other men have thought, and said, and done. Even this is only half of the full duty of a cultured engineer. He should not only know the best that others have thought, and said, and done, but he should, as far as he may be mentally able, have contributed to the thought, and writings, and doings of the world. The engineering, above all other professions, demands that its members shall not be solely scholars, nor yet students of unsolved problems, but they shall have solved some of the problems which have pressed upon civilization for solution. Engineering teachers should be not scholars solely, nor yet students only, but pioneers and creators in the work of civilization. The first live in the spiritual palace called a library, where time, memory and the receptive faculties are alone required. The student lives in the laboratory where

the powers of observation are developed, logic reigns and laws are discovered. The successful engineer lives on the frontier of civilization, on the firing line of human endeavor, where those material problems have to be solved that have been set for the ages, and where the art of creation is wedded to the science of industry. The scholar deals with the past. The student lives in the present. The engineer looks into the future and solves its problems.

To be a good engineering teacher, one must be something of a scholar, student and creator and, highest of all, an educator capable of leading others to be the same. Such men are necessarily scarce, and while their financial rewards may be small, the satisfaction that they very properly get from their work transcends all their many self denials and enables them to hold their heads up with the world's best people.

This society was formed for the promotion of the kind of education which has been described. This is its twenty-first annual meeting. It may be now said to be of age. In closing this address I desire to leave with the next program committee and the incoming officers just two suggestions with the hope that they may be possible of adoption.

Let the program next year include a rousing session on "Education as a Science, rather than as an Art." Those of you who are familiar with the proceedings of the society know that we have had the subject of education considered as an art dealt with from many points of view. Until this meeting, little, if anything, has been done to consider the rationale and science of our chosen profession of education. Let the best minds in the educational world tell us, and in a practical way, all that time will permit concerning the science of education, including its psychology as applied to engineering education. Schools of salesmanship have their special courses in the psychology of their chosen vocation; but did any one ever hear of a course in psychology being demanded as a part of the necessary training required for the engineering teacher? As training and instruction in the normal school are required of grammar-school teachers, and as graduation from a college of arts or of education is expected or demanded from the would-be high-school teacher, and since successful courses are given in our colleges of education on how to teach mathematics, chemistry and physics, surely courses are needed on how to teach the applications of these subjects. Hence I claim that some professional training in education should be required of the man who desires to impart his knowledge and to train young men for the practise of the engineering profession. We are engineering educators. Why should we be required to possess much professional knowledge and training in engineering and none in education?

And this leads me to my last suggestion, which is that the faculties of some of those universities which maintain colleges both of engineering and of education should offer in their summer terms strong courses of study in psychology and in education considered both as a science and as an art. These should be conducted by their most virile and experienced men, and college presidents, deans and heads of departments should be requested to influence their younger assistants and fresh graduates who expect to go permanently into the work of education to take these proposed courses of study in the summer term in preparation for their work in the college of engineering in the succeeding year. If this is done, more engineering teachers will become engineering educators.

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PRACTICAL WORK IN SCIENCE TEACHING

Most of us, and particularly those who are interested in teaching some one special branch of learning, are likely to forget that the great aim of all educational processes is to uplift and benefit humanity; and are likely to hold an exaggerated opinion of the value of our special branch in the general scheme of education. This view is perhaps natural and justifiable, since without it enthusiasm could not exist and teaching would lose much of its pleasure. The breaking away from the older forms of stereotyped abstract forms of education where a somewhat narrow point of view was so long held came in response to a demand that men be free to study *all* forms of natural phenomena living or lifeless and to draw therefrom spiritual inspiration or bodily sustenance as might be available. This movement was greatly aided and hastened by the fact that the conclusions drawn from the study of natural phenomena were of direct use in industry. They were to a large extent, and are still, the result of industrial demands and in so far as they answer these demands they have been of tremendous assistance in affording better support to human life, which after all is the great central problem. In later years this movement has been further strengthened by the discovery that the study of natural phenomena led to a certain form of mental training that afforded a powerful means of attacking abstract problems. The term "scientific method" has come to mean a somewhat definite way of approaching the solution of all problems as opposed to older and so-called empirical methods. And at the same time it has appeared that this same study of things mundane, if properly conducted, actually bestowed upon the student thereof a certain amount of general or liberal training, greater perhaps than the adherents of the old school would admit, and less perhaps than the more ardent advocates of the new methods usually claim.

From time to time we are warned by educational reformers that education to be effective must be kept close to the ground, and must draw its inspiration from the life of the community it tries to serve. Education *is* life and not merely preparation for life, and all forms of educational effort that ultimately survive will be those that in some way throw light on the current problems of existence. That this is so can not be doubted by any one that has noted the changed point of view of many of the older forms of educational effort. History is no longer a mere chronological record of kings and battles, but is rapidly being vitalized into a lesson for the future by *analyzing* the records of the past; and the classics themselves will not reach their highest development and usefulness till they are interpreted by their sponsors, not as the dry and dusty records of past ages, but as vital lessons in the mainsprings of human thought and action. In no document that I know of has this point of view been so clearly and concisely expressed as in the Morrill act, the foundation of our state colleges of agriculture and the mechanic arts, which states that "the leading object of these colleges shall be, without excluding other scientific and classical studies and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts in such manner as the legislatures of the states may respectively prescribe in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." Truly this document may well be called our declaration of educational independence and is worthy of the careful perusal of every teacher.

In the general truth and expediency of these principles most of us are fully agreed. In fact in these days when industry is the idol, not only of our own, but of all other progressive nations, they hardly admit of argument. The teaching of so-called practical courses holds an assured place. But apparently the influence of heredity runs strong in our veins, and no sooner do we lift the study of a practical subject from the realm of empiricism to a scientific basis, than we begin to codify, classify and tabulate its scientific basis, mathematically, chemically and physically. This is a natural and correct thing to do, as it is

the most accurate and most convenient way to express and record the principles of the phenomena that we have studied. It is also the best way in which these principles can be expressed to be of service in future investigations and to scientific men generally. But in our enthusiasm over our specialty we are prone to forget some of the foregoing principles. We are likely to forget that men come in different sizes and grow to different heights; we may forget that the requirements and *capabilities* of the scientist and the plain every-day man are vastly different in *character,* though perhaps not so different in *degree.* As a matter of fact, our public school system is founded on the supposition that all men are born equal in opportunity as well as in an intellectual sense, which is far from being a reality. The result is that most of our educational processes tend to grow away from industry and the soil and the preparation of those that are to labor in the more humble callings and to take cognizance only of those who are, presumably, to occupy the higher positions. No thinking man can doubt the supreme importance of training leaders; it is hardly a debatable question. But in so doing we should not forget that in these days intelligent leadership is useless or at least greatly handicapped without intelligent followers; and our educational methods should take cognizance of *all* kinds of men, keeping in mind that the vast majority of these will always be found in the ranks of the followers.

So there has lately grown up a sentiment that our science teaching is drifting away from the close contact it should have with life and democratic education. We are confronted with the strange charge that our science courses, formerly looked upon by the classical scholar as the very essence of things practical, are no longer practical. We are told that they are neither life itself nor preparation for life. We are told that just as the older educational methods erred in supposing that the repeating of words and the observance of forms produced educated men, so we are likely to mistake the shadow for the substance in expecting to send out men trained in the scientific method and filled with the scientific spirit simply because they have worked over and perhaps memorized certain standard forms of mathematically expressed scientific laws. In other words, we are charged with transferring the error of the older methods to new fields, and the cry has gone forth that science teaching must be again vitalized, that it must be made more practical and brought back close to the industries whence modern science sprung. Most of us will admit freely that there is some truth in these assertions, particularly as regards the failure of our highly developed science courses to take cognizance of the needs of the great mass of men and women who go no further in academic work than the end of the high school course. The majority of them do not engage in callings where expert scientific knowledge is an essential. Yet all should have some scientific training, first to acquire, if possible, the scientific method of attack, because this is the weapon with which we have made ourselves masters of physical things, and second that they may be reasonably intelligent regarding the natural phenomena that surround them on every hand with ever increasing complexity. There is no doubt that high school science can be made more effective for the great mass of the people by making it somewhat less formal, and bringing it closer to the lives of the plain people.

But before we proceed far with our reformation it may be well to define first just what we mean by *practical scientific education.* Do we mean (1) the giving simply of descriptive information and explanations of every-day phenomena; or do we mean (2) the using of these every-day phenomena to interest the student in rediscovering the laws that underlie them; or again do we mean (3) the application of these rediscovered principles, formally expressed, to practical every-day problems in sufficient degree to secure to the student ability to handle the formal mathematical statement of these principles in an easy and confident manner.

A very cursory examination of college and high school curricula will show that all three of these progressive steps are in common use.

I have in mind a certain course given in a certain college, that shall be nameless, that is strictly of the first kind. It is eminently practical and I believe it is as eminently useless as far as mental development is concerned.

This interpretation of practical education is common and the inadequateness of this form of instruction *taken by itself* is so glaring when compared with some of the old and much-maligned classical methods as to make one pause and wonder. Yet there are, as we shall see, places in our educational structure where such courses are not only desirable but necessary. The error comes in assuming that they are sufficient unto themselves as educational tools.

The second interpretation forms the basis of the arguments presented by some of those who would reform our high school science teaching. The claim is made, and with good reason, that the interest of the student is much more readily secured through familiar *visualized* physical phenomena than through the abstract mathematical statements of the underlying principles. Once his attention and interest are secured, it is easy to lead him to investigate and rediscover these laws, thereby acquiring a general knowledge of the phenomena and also the scientific method of approach which should be of use in attacking the many other problems of his life. Or, as Professor Mann[1] has expressed it, the present order of procedure is usually: principle, demonstration, exemplification in laboratory, application; while the newer ideas would make the order: application, problem, solution in the laboratory, principle. Professor Mann's reasoning for this order is based on his definition of the benefits to be derived from the study of physics (and the same argument holds for all other fundamental sciences). These benefits he says are of two kinds; they consist of (1) useful knowledge of physical phenomena; (2) discipline in the methods of acquiring this useful knowledge. No fault can be found with this statement as far as it goes and, as will be shown, there are parts of our educational structure where this form of instruction, like the former one, is not only justifiable but sufficient. The error again is in assuming that this order of procedure forms an educational basis sufficient for all men and all forms of study. Let us see where this reasoning will carry us.

As this writer himself points out, knowledge of physical phenomena and discipline in acquiring it may be either *specific* or *general*, and specific knowledge and training acquired by studying some special field becomes more and more useful as it becomes more and more general by being used and interwoven with a wide range of experience. This is true not only of scientific studies, but of all forms of educational effort. Let us then apply this new theory to the teaching of some simple fundamentals such as reading and spelling, where, incidentally, the method of approach advocated is already well developed. By means of the common objects of the child's environment he soon is taught the principles of reading and spelling and may acquire not only much information regarding these objects, but a considerable mental development in attack, with a considerable knowledge of the principles involved in reading and spelling. But he is still a long way from being able to either read or spell even after these principles have been made evident to him. He must now *apply* these principles long and tediously before he can master this fundamental study. This is even more marked in mathematics. Approach through applications, demonstrations and investigation to secure data, and the discovery of the principles involved are not sufficient. To use these principles freely requires long and close application of them, and while this labor may be made more interesting by using practical problems, there is a *quantitative* element that can not be overlooked. This is very clearly instanced in the case of factoring in algebra. Many cases of a similar kind may be cited even when the processes are manual in their character. It is easy, for example, to approach the making of good letters and figures through the making of mechanical drawings of some familiar object that the student is interested in. But even after the student

[1] "The Teaching of Physics," p. 213.

sees the application and need of good letters and figures, and even after he has had the theory of any good system of lettering carefully expounded, he will never make good characters till he has toilsomely applied that theory many, many times. Again we may awaken the interest of the student in, say, the art of planing wood with a hand plane by showing first the principles of power planing machines and then the construction and principles of hand planes. But he will never master the use of the instrument except through persistent and often toilsome effort, even though that effort be made interesting by application to practical problems. And the general principle is true of all fundamental work, mental or manual, that the student expects to build upon for the future. There is a tremendous difference between knowing a lot about general physical phenomena with the methods of finding the principles involved, and the power to use the formal statements of these principles in attacking other problems. And while, as before stated, it may sometimes be desirable and sufficient to stop at the end of the first or second stage noted above, care must be exercised that this is not done in any subject where the accurate and confident use of the formal principles rediscovered are essential to future progress. Evidently this applies to the teaching of all elementary fundamental subjects, but the dividing line may perhaps be made more clear by studying the problems presented in so-called industrial education, which is very likely to be effected by this new movement.

Aside from inherent ability and general or liberal knowledge the accomplishments that industrial workers must possess are of three kinds: (1) Manual skill; (2) industrial or manufacturing knowledge; (3) scientific knowledge and the ability to *use* it. The first is self-explanatory. The second refers to the knowledge of shop processes and methods of manufacturing and the finance and economics of production. The first two may be partially acquired in schools, but as a general principle their full attainment must be acquired in the atmosphere of the shop or factory. The third refers to the knowledge of the natural scientific laws that may, in general, be acquired from books better than from actual shop work. Now the position which an industrial worker may occupy is governed by the relative amount of these three accomplishments that he may possess. Thus a good tool-maker must possess a certain amount of scientific knowledge and must possess a maximum of manual skill. The shop manager must possess a certain amount of scientific background but must be highly informed regarding manufacturing methods. The engineer must have some manual skill and shop knowledge and must be well grounded in scientific principles and their application. It is important to note that he must not only have a general knowledge of the scientific phenomena on which his work is based, but he must be able to *apply* their formal mathematical expressions freely and accurately. Superficial knowledge is not enough. In his most highly developed form the engineer must pass out of the realm of visualized principles and reason with abstruse, abstract scientific phenomena far removed at times from the practical. The ability to do this requires not only a full knowledge of principles but an ability to use them that can come only from long and persistent practise. And it is to be especially noted that the foundation of this ability must be laid in the school. Time was when a bright man could easily acquire in the shop the scientific background required for any engineering work. The complexity of modern engineering has, however, changed all this and the man who is to rise to any height in the field must in general acquire this scientific background before he enters it. *Men seldom add to their scientific base line after leaving school,* and the height to which they rise along scientific lines is measured almost absolutely by the amount of solid scientific training they take away from the school. This is not dogma, but history, and can be easily verified by any one. It is particularly true of the electrical engineer and similar industrial workers in the higher levels of industry.

But *all* the courses offered to the embryo electrical engineer need not be of the searching character indicated by the above. Thus

his principal work in life may be "buttressed" and made more effective by a course in steam engineering, for instance, that goes no further than the second stage mentioned above. It is sufficient if he knows the *forms* of steam apparatus and the general principles underlying their construction without ever applying these principles to design or investigation. On the other hand, the steam engineer and civil engineer are rounded out and their work made more effective by a course in the forms and characteristics of electrical machinery without going into the rigid application of the fundamental principles involved. It thus appears that we may with good logic stop at either the first or descriptive stage or at the end of the second or experimental stage of a given line of instruction, provided we properly interpret the effect; but for fullest mental development and ability to make practical use of the theory involved the process must be continued through the phase of thorough mathematical application.

What is true of the college is true also of the secondary school. When we have fully developed our secondary school system we shall have several, if not many kinds of such schools. The preparation of the few going to engineering colleges will be conducted more and more along the lines of general or humanistic studies. They will study fewer courses and will study them more thoroughly. For the many going out into the world from the high school we shall have, as before stated, several kinds of schools all with vocational direction and some of them plain trade schools. Each one of these schools will have a central course or courses carried as far as possible through the third stage, and these central courses will be strengthened and buttressed by other practical or scientific courses that will be stopped not later than the end of the second stage. Some of these central courses will be very practical and some more mathematically scientific than we may perhaps imagine. For industry tends to become more scientific and as a consequence more mathematical. If one doubts this he should look carefully into the mathematical work involved in reducing to workable form, Mr. W. F. Taylor's[2] experiments in the very practical study of the laws underlying the cutting of metals. It required high mathematical attainment to solve what might seem at first to be a simple practical problem, and to-day many workmen in this country are doing such extremely practical work as setting the cutting speeds and feeds of machine tools by means of slide-rules the mathematical basis of which is far beyond their conception. And these same general observations and principles will apply throughout the entire range of vocational education. This, I believe, is the true interpretation of this new movement.

There *is* a place for courses much more practical and more attractive to the student than those built solely along mathematical lines. But do not let us delude ourselves that this idea constitutes a complete new educational scheme. In this connection it is well for us to remember the history of some of the educational reform movements we have already witnessed. When we tore away from the old classical form of education it was firmly believed that we could build up an educational edifice that would give as good, if not better results, not only as regards mental development, but as regards general training and outlook on life. It is interesting to note that the engineering colleges, that have benefited by this separation as much if not more than any other form of educational activity, long ago realized that we can not profitably throw away human experience and have already begun to swing back and more and more to build their work on the humanities as a sure foundation. When the broadly elective system was brought forward it was heralded as the final solution of educational problems, but already we have evaluated its influence and adopted it partially, only, in the form of elective *groups* of study. And so this new movement in science teaching can not disregard human experience. No power of concentration and no mental development worth while can ever come about except by hard and unremitting toil. We may

[2] See *Trans. American Society of Mechanical Engineers*, Vol. 28.

sweeten the dose, but to be fully effective the student must swallow it all, including the rigorous drill that can come only from the many applications that must be made before the benefit becomes an integral part of his personality.

And I am not so sure that we may not do some harm by oversweetening the dose. The theory that there is no pleasure in abstract mental effort is in my opinion more or less of a fallacy. There is a certain satisfaction that comes from successful effort, whether the work accomplished be abstract or practical. Students are naturally more interested in practical than in theoretical matters, and a teacher lacking in inspiration can very well help his work by a careful choice of illustrations. But to the student who sits under a teacher whose instruction is illuminated by the "divine spark" all things are interesting, whether they be music or logarithms. Let us not confuse *mechanism* with *inspiration*. Furthermore, it is a good thing for boys and girls to be compelled to do a certain amount of uninteresting if not unpleasant work. The duties of life are not, on the whole, entirely pleasant; and since proficiency in overcoming obstacles is obtained only by overcoming a few, perhaps a little uninteresting work is a good thing, after all. Huxley says, "the best way to learn how to do a thing is by doing something as near like it as possible, but under easier and simpler conditions." There is no royal road to learning; and if the three R's are the basis of our educational methods, so the way of mastering them and attaining the mental heights their mastery leads to lies through the three T's. No high mental development ever has or ever will be accomplished without a liberal application of toil, trouble and tears.

DEXTER S. KIMBALL

January 17, 1913

THE MINING CONGRESS AND EXPOSITION IN PHILADELPHIA

MANUFACTURERS of mining machinery, rescue and first-aid apparatus and safety appliances are to be given an opportunity to display their wares before the mining men of the country at an industrial exposition to be held under the auspices of the American Mining Congress, in Philadelphia, Pa., during the week of October 20.

This exposition, the first of its kind in this country, will be held in conjunction with the annual convention of the Mining Congress. It will be national in scope, the metal mining interests of the west to be as fully represented as the coal mining of the east. There is a tentative plan to have a gold mining camp in full operation with a mill crushing the ore. Horticultural Hall, situated in the heart of the city, has been engaged for the occasion.

While the plans are still in embryo, a number of the leading manufacturers have already been approached and have shown sufficient interest to lead to the belief that all the space will be taken.

A number of the large coal companies that have developed the "safety first" movement at their mines are arranging for space to show the mining men and the public what they are doing in behalf of their men. These companies will send rescue and first-aid crews and there is talk of exhibition drills between the various crews. The U. S. Bureau of Mines will be represented by one of its safety cars and a picked crew of helmet men. The state of Illinois and a number of the anthracite companies may send rescue cars for exhibition purposes.

The convention is the first to include all the mining interests of the country and an attempt is to be made to show the need of a stronger national organization that will represent all phases of the industry. Perhaps the leading topic of the convention will be the new system of mine taxation recently put in operation in some states and being discussed in others at the present time. It is expected that a definite policy toward Alaska from congress will be asked.

The smelter fume problem will be discussed with the hope that an amicable adjustment may be reached soon. California has, at the present time, two commissions considering this problem and Montana, one.

The disposal of debris from placer mining is

another question that will be discussed by western men. They will declare that the placer mining industry of California has been nearly wiped out through drastic rules and regulations, some of them imposed by the U. S. government. At the present time the debris question is in charge of a commission of the United States army engineers and it is claimed that while they zealously watch the interests of the farmers, they know nothing about the mining problem. A demand may be made for the inclusion of a mining engineer on this board to see that the interests of the mines are protected.

The coal men of the east will be mostly interested in two problems, the "safety first" movement and the conservation of the coal lands adjacent to the great eastern industrial centers. This latter, it is said, has become a question of most serious moment. It is fully realized by the eastern men that their coal fields are being used up at a tremendous rate and that when these coals are gone, it will be useless to think of getting coal from the west, for the commercial prosperity of the east depends upon a supply of coal at reasonable price and transportation charges from the west would be too great.

The proposed system of leasing mineral lands will also come up for extended discussion. The fact that the federal government some time ago leased coal lands in Wyoming to a coal company, thus making the entering wedge in this system of disposing of the government's mineral lands, will undoubtedly call for comment. Then there is the proposal for the revision of all the mining laws of the country. A great many mining men are of the opinion that the laws are antiquated and cumbersome, imposing hardship upon every one who has to deal with them.

MEMORIAL TO SIR WILLIAM LOGAN

On July 16, in the little fishing village of Percé, on the Quebec shore of the Gulf of St. Lawrence, a memorial was unveiled to Sir William Edmond Logan, Kt., LL.D., F.R.S., founder and first director of the Geological Survey of Canada. The day selected for this interesting event was the occasion of the visit of seventy members of the International Geological Congress to the Gaspé country and the memorial was erected by the Congress to commemorate the important official services of Sir William Logan which began in Gaspé in 1842. Though the day had been set apart for the exploration of the picturesque and involved geology of Percé, a half hour was appropriately devoted to the ceremony of effectively reminding the visitors who it was that first lifted the veil from the geological problems of Gaspé. The memorial is a bronze slab bearing a strong and effective medallion portrait of Sir William accompanied by a suitable inscription and is the highly artistic work of Mr. Henri Hébert, of Montreal. It has been attached to the face of a natural rock wall in the heart of Percé village. At the unveiling ceremony suitable addresses were made by Dr. A. E. Barlow, chairman of the Logan Memorial Committee, and by Dr. John M. Clarke. As a further expression of their desire to establish the memory of Logan and his work in Gaspé, and to acknowledge their appreciation of the extraordinary attractions of Percé, the committee contemplates acquiring the land about the present memorial in order to present it to the town as a public park.

SCIENTIFIC NOTES AND NEWS

The Kelvin Memorial window in Westminster Abbey was dedicated on July 15. The dean of Westminster made the address and the ceremonies were attended by many distinguished scientific men. The window, which was designed by Mr. J. N. Comper, is in the east bay of the nave on the north side. The light from it falls upon the graves of Kelvin and Isaac Newton, and immediately beneath it are the graves of Darwin and Herschel.

A committee has been formed to erect a memorial in honor of the late Sir William White, the distinguished naval architect, at the time of his death president of the British Association for the Advancement of Science.

Former students of Ralph S. Tarr, of Cornell University, wish to place on the campus

a permanent memorial of his work. They have thought that a suitable memorial would be a boulder carved so as to form a seat and bearing an inscription. If a boulder is found that can be brought to the campus it will probably be placed on the brow of the hill near McGraw Hall, where Professor Tarr taught physical geology for twenty years.

LORD AVEBURY has bequeathed one thousand pounds to the University of London to found a prize in mathematics or astronomy in memory of his father, Sir John William Lubbock, first vice-chancellor of the university.

A NUMBER of the friends of the late Samuel Franklin Emmons have presented to Columbia University a memorial fund for the endowment of the "Emmons Geological Fellowship," the purpose being to continue, through investigations and publications, the scientific research carried on by Mr. Emmons during his lifetime, more particularly in the field of economic geology. The fellowship will be awarded from time to time to graduates of any college or university who show exceptional capacity, by a committee consisting of Professor James F. Kemp, professor of geology in Columbia University; Professor John D. Irving, of the Sheffield Scientific School, Yale University, and Professor Waldemar Lindgren, of the Massachusetts Institute of Technology. The recipient will be at liberty to travel and to conduct his investigations either in this country or abroad.

BY the will of the Rev. L. C. Chamberlain, who died at Pasadena, Cal., on May 9, $25,000 is bequeathed to the Smithsonian Institution for its mineralogical collections, and $10,000 for its collection of mollusks. There was also bequeathed $5,000 to the Academy of Natural Sciences in Philadelphia for increasing and maintaining the Isaac Lea collection of Eocene fossils. These bequests were made for the benefit of the scientific work in which Isaac Lea was interested, Mrs. Chamberlain having been the daughter of Isaac Lea and having inherited the money from him. Mr. Chamberlain also bequeathed $100,000 and his residual estate to the Thessalonica Agricultural and Industrial Institute, Turkey.

AMONG the degrees conferred by the University of Michigan at its recent commencement was the degree of doctor of laws on Dr. John Dewey, professor of philosophy at Columbia University, and the degree of doctor of science on Dr. Ludwig Hektoen, professor of pathology at the University of Chicago; on Dr. Lafayette B. Mendel, professor of physiological chemistry in the Sheffield Scientific School of Yale University, and on Dr. Armin O. Leuschner, professor of astronomy and dean of the graduate school of the University of California.

ST. ANDREWS UNIVERSITY has conferred its doctorate of laws on Dr. G. A. Boulenger, of the natural history department of the British Museum.

DR. HARRY C. JONES, professor of physical chemistry at the Johns Hopkins University, has been awarded the Edward Longstreth medal of the Franklin Institute of Philadelphia for his work on the nature of solutions.

PROFESSOR VON WASSERMANN has been appointed head of the newly-established Kaiser Wilhelm Institute for Experimental Therapeutics, one of the laboratories founded by the Kaiser Wilhelm Society for Scientific Research.

MR. C. W. MASON, of Wye, England, and Mr. Donald McGregor, of Oxford, have been appointed Carnegie scholars in entomology under the Imperial Bureau of Entomology. Mr. Mason arrived in the United States early in July and is now studying at the laboratory of parasitology of the Bureau of Entomology of the U. S. Department of Agriculture at Melrose Highlands, Mass. He will study in this country for one year. Mr. McGregor will arrive in New York soon and will probably join Mr. Mason at Melrose Highlands.

IN accordance with the decision of the council of the American Association for the Advancement of Science, Dr. Robert M. Ogden, of the University of Tennessee, has been appointed by the committee in charge of making the selection of the temporary asso-

ciate secretary of the American Association to further the interests of the association in the south and to promote the meeting to be held next winter at Atlanta, Georgia. Dr. Ogden will enter upon his duties the first of next October.

Mr. F. P. Gulliver, as geographer of the Chestnut Tree Blight Commission of Pennsylvania, is studying the relation of soil and climate to the growth of chestnut trees and the spread of the blight.

Mr. O. E. Jennings, of the Carnegie Museum, Pittsburgh, is engaged in a botanical expedition to the north of Lake Superior to study the ecological distribution of plants.

Professor W. M. Davis, of Harvard University, delivered two lectures before the students in geology and geography at the summer session of Columbia University, on "The Mountains of the Great Basin" and "Principles of Geographical Descriptions." Professor G. A. J. Cole, director of the Geological Survey of Ireland, addressed them on "Ireland, the Outpost of Europe."

Director Charles E. Thorne, of the Ohio Agricultural Experiment Station, gave an address on July 15, at the University of Illinois, on "The Relation of Cattle Feeding to Soil Fertility." The occasion was the attendance of 250 cattlemen to inspect the baby beeves that had just completed a 210-day feeding experiment.

Dr. Robert von Lenderfeld, professor of zoology and director of the Zoological Institute in Prague, has died at the age of fifty-six years. Dr. von Lenderfeld's numerous and valuable publications in zoology, especially those on the morphology and classification of sponges, are well known. At the time of his death he was rector of the German University in Prague.

Civil service examinations are announced as follows: chief in the Office of Information, Department of Agriculture, Washington, at $2,500 a year; bacteriologist at a salary ranging from $1,800 to $2,000 a year in the New York food and drug inspection laboratory, Bureau of Chemistry, Department of Agriculture.

The minister of public instruction of Argentina has authorized the preparation of an expedition from the National Observatory at Córdoba to observe the total solar eclipse which will occur on August 20–21, 1914. The expedition will be composed of three members of the observatory staff, with an extensive equipment of instruments and will proceed to a point (as near to the central line as possible) in southern Russia, not far from the Black Sea. It is expected that the expedition will be joined by astronomers from the Berlin, Potsdam and Koenigsberg observatories.

Secretary Houston has announced that hereafter the Department of Agriculture will send a weekly letter to the correspondents of the department, giving the latest agricultural information of value to the farmer. The letters will treat of crop conditions and prices, the discovery of new plant or animal pests, pure food decisions, and those which affect users of irrigated land and the national forests, and any other work of the department which can benefit the farmer. The letter is to be sent weekly, so that the news may reach the farmers promptly. The *Crop Reporter,* a monthly publication which has been issued by the department for some years past, is to be discontinued, Secretary Houston having decided that it reached the farmers too late to be of any practical use.

The first annual meeting of editors of publications of agricultural colleges in the middle west was held at the University of Illinois on July 10. Representatives of six states met and discussed informally the problems in connection with the gathering, editing and publication of agricultural material. It was voted to hold a session in 1914, to which many other states will be invited. The association elected Dr. B. E. Powell, of Illinois, executive secretary to make necessary arrangements for the next meeting.

Following is the New York Botanical Garden's program of late summer lectures, which will be delivered in the museum building,

Bronx Park, on Saturday afternoons, at four o'clock:

August 2, "American Desert Plants," by Dr. William Trelease.

August 9, "The Biology of Cheese," by Dr. Charles Thom.

August 16, "Wild Flowers of the Late Summer," by Dr. N. L. Britton.

August 23, "Explorations in Mexico, II.: Mexico City to Cuernavaca," by Dr. W. A. Murrill.

August 30, "The Mammoth Trees of California," by Dr. Arthur Hollick.

September 6, "Shade Trees and their Enemies," by Dr. F. J. Seaver.

September 13, "A Visit to the Panama Canal Zone," by Dr. M. A. Howe.

September 20, "Scenic and Botanical Features of Devil's Lake, Wisconsin," by Dr. A. B. Stout.

September 27, "Explorations in Mexico, III.: Colima and Manzanillo," by Dr. W. A. Murrill.

ARRANGEMENTS have been made between the New York State College of Forestry at Syracuse University and the Palisades Inter-State Park Commission whereby the College of Forestry will prepare and carry out a plan of management for the 14,000 acres of forest land controlled by the commission and lying along the Hudson River. The work of getting the forest land into shape will be started about the middle of August by four advanced students under the direction of Professor Frank F. Moon, of the College of Forestry, who was forester for the former Highlands of the Hudson Forest Reservation. The various properties will be mapped out and studied to ascertain the amount of the timber now standing and the amount to be removed. In addition, the fire problem will be studied and eventually a long term reforestation plan put into force. Centers of insect and fungus damage will be located and timber will be marked so that during the coming winter the park employees will be busy removing the dead, diseased and undesirable specimens. A forest nursery will be developed and active reforestation begun in 1914.

THE national congress of Brazil has passed and the president of that republic has approved a law fixing legal time in Brazil. Following is a translation of the bill:

Art. 1. For purposes of international and commercial contracts the meridian of Greenwich shall be considered fundamental in all Brazil.

Art. 2. So far as the legal hour is concerned Brazilian territory is divided into four distinct zones as follows:

(*a*) The first zone includes the archipelago of Fernando de Novorha and the island of Trinidad, and shall have Greenwich time "less two hours."

(*b*) The second zone includes all the coast, all the states of the interior (except Matto-Grosso and Amazonas), and the part of the state of Para east of a line starting from Mount Grevaux on the frontier of French Guyana, following down Rio Pecuary to the Javary, along this last river to the Amazonas, and southward along the Rio Xingu to the state of Matto-Grosso. This zone shall have Greenwich time "less three hours."

(*c*) The third zone includes all of the state of Pará west of the line just mentioned, the state of Matto-Grosso, and all of the state of Amazonas east of a line drawn on a great circle starting at Tabatinga and ending at Porto Acre. This zone shall have Greenwich time "less four hours."

(*d*) The fourth zone includes the territory of Acre and the region west of the line just mentioned, and shall have Greenwich time "less five hours."

THE following letter from President John C. Branner was published in the *Journal do Commercio,* Rio de Janeiro, June 14, 1913:

The first volume of the "Monographs of the Geological and Mineralogical Service of Brazil" has just appeared, published by the Ministry of Agriculture, Industry and Commerce. It bears the title "Devonian Fossils of Parana, by Dr. John M. Clarke," Rio de Janeiro, 1913.

It is a work of the greatest importance to science, not only that of Brazil, but of the foreign world as well.

The Federal Geological Service has been in operation in Brazil for six years. In this relatively short time the director has, amongst many other achievements, succeeded in bringing together an important collection of Devonian fossils of the highest interest to science and in inducing Dr. Clarke, the official geologist of the state of New York and one of the highest authorities on this subject, to undertake their study, description and discussion. In the words of Dr. Clarke himself, "the results are of world-wide import." The interest and importance of this monograph are due, in great part, to the fact that the studies embrace,

aside from the Devonian fossils of Parana, those of Matto-Grosso, the Amazonas [Argentina] and the Falkland Islands, while the general conclusions extend to the Devonian of all the continents of the world.

The text of this monograph, in Portuguese and English, covers 353 pages, which are accompanied by 27 handsome plates printed in Germany by the most advanced processes of the lithographic art.

This fine work as a contribution to pure science does honor to the author, to the director of the Geological Service, to the Ministry of Agriculture and to the country.

The composition and characteristics of the population of Hawaii, as reported at the Thirteenth Decennial Census, are given in a bulletin soon to be issued by Director Durand, of the Bureau of the Census, Department of Commerce. It was prepared under the supervision of Wm. C. Hunt, chief statistician for population. Statistics are presented of number of inhabitants, increase and density of population, proportions urban and rural, race, nativity, parentage, sex, age, marital condition, place of birth, males of voting and militia ages, citizenship, year of immigration of the foreign-born, school attendance, illiteracy, inability to speak English, and number of dwellings and families. A previous population bulletin for Hawaii gave the number of inhabitants by counties and minor civil divisions. That and the forthcoming bulletin cover all the principal topics of the population census except occupations and the ownership of homes. The population of Hawaii at each census from 1832 to 1910, inclusive, was as follows: 1832, 130,313; 1836, 108,579; 1850, 84,165; 1853, 73,138; 1860, 69,800; 1866, 62,959; 1872, 56,897; 1878, 57,985; 1884, 80,578; 1890, 89,990; 1896, 109,020; 1900, 154,001, and 1910, 191,909. Racially the population of the territory is extremely heterogeneous. In 1910 the pure Caucasian element numbered 44,048, constituting 23 per cent. of the total population. Of this class, which is itself composed of diverse racial elements, 22,301, or slightly more than one half, were Portuguese; 4,890 were Porto Rican; 1,990 were Spanish, and 14,867 were of other Caucasian descent. The Japanese, numbering 79,675, constituted 41.5 per cent., or more than two fifths, of the total population, while the Japanese, Chinese and Koreans combined, numbered 105,882, or 55.2 per cent., of the total population. Persons of pure native Hawaiian stock numbered 26,041 and constituted 13.6 per cent. of the population. In the decade 1900–1910 the number of Caucasians in the population increased 15,229, or 52.8 per cent., the percentage of increase for this race being practically the same in this as in the preceding decade. The increase of the Japanese in the decade 1900–1910 was 18,564, or 30.4 per cent. In the same period the Chinese decreased 4,093, or 15.9 per cent. The number of pure Hawaiians decreased from 34,436 in 1890 to 26,041 in 1910, the decrease in the decade 1900–1910 being somewhat less than that in the preceding decade—3,758, or 12.6 per cent., as compared with 4,637, or 13.5 per cent. Slightly more than one half (98,157, or 51.1 per cent.) of the population in 1910 was native, and slightly less than one half (93,752, or 48.9 per cent.) foreign born. The native element embraces all persons born in Hawaii, or in any state or outlying possession of the United States. Persons born in Porto Rico or in the Philippine Islands, whether of Porto Rico, Filipino, or other racial origin are accordingly classified as native. For the Japanese the percentage native was 25; for the Chinese, 33.2; for the Portuguese, 61.7, and for the "other Caucasian" element, 66.7.

UNIVERSITY AND EDUCATIONAL NEWS

The board of trustees of the University of Illinois at a recent meeting voted to reopen the college of dentistry which was closed in 1911 because of no appropriations. Doctor Frederick B. Moorehead, of Chicago, was appointed dean of the new dental college. The principal items in the new building program for the immediate future are: An addition to the chemistry laboratory, costing $250,000; an extension on the commerce building, costing $125,000; a school of education building, costing $120,000; a woman's residence hall, $100,000; another engineering building, costing $100,-

000; completion of armory, $90,000; a boiler house, $45,000; addition to the natural history building, $65,000; ceramics building, $65,000; addition to library and horticultural buildings, $48,000; stock judging pavilion, $30,000; for an extension of the present university campus and for an enlarged agricultural building, $400,000 was voted.

M. PIERRE BOUTROUX has accepted a professorship of mathematics at Princeton University, and will assume his duties in the autumn. M. Boutroux is a son of the distinguished professor of philosophy, M. Emile Boutroux, and is closely related to the Poincaré family.

DR. R. E. MCCOTTER, instructor in anatomy in the University of Michigan, has been appointed professor of anatomy at Vanderbilt University.

MR. FREDERICK DUNLAP, assistant in the forest service, physicist at the Forest Plant Product Laboratory and lecturer in the University of Wisconsin, has been elected professor of forestry in the University of Missouri.

THE following appointments have been made at Northwestern University: Edward Leroy Schaub, Ph.D., of the University of Iowa, to be professor of philosophy William H. Coghill, M.E., to be assistant professor of mining and metallurgy; William Logan Woodburn, Ph.D., to be assistant professor of botany; Elton J. Moulton, Ph.D., to be assistant professor of mathematics; Charles Ross Dines, Ph.D., to be instructor in mathematics; George Leroy Schnable, M.A., to be instructor in physics; Paul Mason Bachelder, M.A., to be instructor in mathematics; Harlan True Stetson, M.S., of Dartmouth, to be instructor in astronomy; Gilbert Haven Cady, M.S., of the University of Chicago, to be instructor in geology and mineralogy.

DISCUSSION AND CORRESPONDENCE

THE WORD "SELVA" IN GEOGRAPHIC LITERATURE

I WISH to enter a protest against the use of the Portuguese word "selva" as applied to the forests of the Amazon Valley in geographic literature. I am under the impression that the word was formerly used by several writers, but that it has been pretty generally dropped of late as unnecessary. This is written away from my library, however, and it is not possible to verify this statement at present.

In Mr. James Bryce's late book, "South America; Observations and Impressions, New York, 1913," the word "selva" is used as if it were not only the every-day and generally accepted name of certain and particular Brazilian forests, but as if it were so descriptive, so characteristic, and so appropriate that no English word could take its place.

I quote a few of Mr. Bryce's expressions:

> The great Amazonian low forest-covered country —the so-called Selvas (woodlands) (p. 168). The great central plain of the Amazon and its tributaries which the Brazilians call the Selvas (woods) (p. 555). The Selvas or forest-covered Amazonian plain (p. 558).

I regret to have to say that I know of no reason whatever for such a use of the word *selva*. In the first place, it is not the word used in Brazil either for the Amazonian forest or for any other forest, Mr. Bryce to the contrary notwithstanding. It is true that it is a good Portuguese word, but it is not in common use, and during the forty years I have been acquainted with Portuguese language I doubt if I have heard it used by a Portuguese-speaking person more than two or three times, and then only in a poetic sense.

The Brazilians speak of the forests of the Amazon as *mattas*, just as they speak of the forests of any other part of the country. In 1907 Dr. H. von Ihering, director of the Museu Paulista in S. Paulo, Brazil, published a paper in Portuguese on the distribution of Brazilian forests. The occasion certainly seemed to offer an opportunity for saying something about the "selvas" and their peculiarities, but I do not find the word "selva" used once in the 53 pages of that article. The forests are there either designated by the special names used in the country, or they are called *mattas*, *mattos* or *florestas*, which are the words in common use all over Brazil.

Besides its use in Mr. Bryce's book, I find "selvas" mentioned in E. W. Heaton's "Scientific Geography; South America," London (1912), at pages 17, 39 and 55. Elsewhere in that book the author seems to get along quite comfortably without the word.

Selva is a Portuguese word like any other, but it is very little used and has no special application to the forests of the Amazon. The Brazilians do not distinguish the forests of the Amazon by any special word; they are called *mattas,* which is the word applied to any and all heavy forests alike.

J. C. Branner

Rio de Janeiro, Brazil,
June 6, 1913

Does a Low-Protein Diet Produce Racial Inferiority?

To the Editor of Science: In your issue of June 13, 1913, is contained a communication by Dr. Edgar T. Wherry entitled: "Does a Low-protein Diet Produce Racial Inferiority?" The purpose of the article is to dispose of two objections that have been raised against such a dietary, by the application of the results of recent investigations. It seems to me that, in attempting the removal of the first objection, the article is open to some misconception, while, in the case of the second objection, the attempted disposal is far from being effective.

Dr. Wherry is presumably dealing with instances of recognized racial inferiority, and the inclusion of the Japanese people in this category, especially by an advocate of the low-protein theory, is a matter of some surprise. That the Japanese exhibit "some points of physical inferiority, or lack energy, aggressiveness, or courage," when compared with the European, for instance, on a protein-rich dietary, is hardly a generally recognized fact, nor is it in harmony with the contentions of Chittenden and others of his belief that in the Japanese we have an instance of a people "who for generations have apparently lived and thrived on a daily ration noticeably low in its content of proteid. . . ." Chittenden utilizes this fact "as confirmatory evidence, on a large scale, of the perfect safety of lowering the consumption of proteid food to somewhere near the level of the physiological requirements of the body," and believes that "generations of low-proteid feeding, with the temperance and simplicity in dietary methods thereby implied, have certainly not stood in the way of phenomenal development and advancement when the gateway was opened for the ingress of modern ideas from western civilization."[1]

The conceptions regarding the etiology of beri-beri have not undergone any radical change in the last year or two. The information that has been accumulated recently in regard to this disease has served to confirm and extend such conceptions, not to revolutionize them. For years it has been definitely known that the use of polished or husked rice is directly or indirectly involved in the causation of beri-beri. In proof of this statement I only need quote the extensive investigations of Fletcher[2] and of Fraser and Stanton,[3] published six and four years ago, the results of which, obtained from large numbers of individuals, point unequivocally to an intimate relation between the consumption of polished rice and incidence to beri-beri. The comparatively recent discovery by several investigators of a constituent in rice-bran which cures the polyneuritis of beri-beri simply confirms the previous work above mentioned. Furthermore, this discovery does not at all militate against the contention that has often been raised that a diet containing a liberal and varied protein value is an effective preventive against beri-beri.

I doubt whether Dr. Wherry would find many dietitians, on either side of the argument, who consider the relation between the protein intake and the incidence to beri-beri one of the "supposedly most typical illustra-

[1] "Nutrition of Man," pp. 222–223.

[2] William Fletcher, "Rice and Beri-Beri," *Lancet,* June 29, 1907.

[3] H. Fraser and A. T. Stanton, "An Enquiry Concerning the Etiology of Beri-Beri," *Lancet,* February 13, 1909.

tions of the unfavorable results of a deficiency of protein in the dietary."

The statement most open to criticism in the article of Dr. Wherry is that concerning the generally recognized inferiority of the native inhabitants of India. A recent estimate obtained by the Rockefeller Sanitary Commission that 60 to 80 per cent. of these people are infected with the hookworm, is supposed to "explain away" this inferiority, without reference at all to the diet in vogue. By those who are familiar with the elaborate investigations of D. McCay of the dietaries of the Bangalis and other races of India, upon which has been based, rightly or wrongly, one of the most formidable arguments against the well-known views of Chittenden, this statement of Dr. Wherry must have been read with no small degree of interest and curiosity.

In Publication No. 6 of the Rockefeller Sanitary Commission for the Eradication of Hookworm Disease, entitled, "Hookworm Infection in Foreign Countries," the estimate above quoted of the degree of infection in India is given on the authority of various medical men who are undoubtedly well-informed on the matter. However, the American Vice-consul, C. B. Perry, is quoted as saying (1911):

> Nothing is being done by governmental agencies to alleviate or eradicate the disease except the usual sanitary measures for the prevention of fecal contamination of the soil and hospital treatment of incapacitated patients. . . . The conclusion that I have arrived at is that though widely prevalent in India, the disease is not considered of a dangerous nature and no special steps have been deemed necessary as yet to combat it.

An editorial appearing in the *Indian Medical Gazette*, a journal from which the Rockefeller Sanitary Commission obtained much of its information concerning conditions in India, in the issue of May, 1913, is of great interest in this connection. In commenting upon a clinical method recently investigated by Stiles and Altman of this country, for determining the completeness of cure in ankylostomiasis (hookworm disease), the following is said:

> It would be interesting to compare the figures with those of India, but in attempting to do so one is faced at once by the difficulty that the question seems to have been approached in the two countries from entirely different points of view. In America, it is evident from the huge number of worms per case, which is well over 1,000, that those are being treated who are suffering from ill-health as the result of infection, that is to say, that they are real instances of ankylostomiasis. In India, on the contrary, the matter has been chiefly taken up as a routine examination of all prisoners admitted into a jail, and most of such men are healthy. In these cases an infection of 100 worms appears to be quite unusual, and quite naturally an infection of a dozen worms will make no appreciable difference to a man. These slight infections are the rule in India, the percentage infected varies in different parts from about 35 to 75 in men of the laboring classes, and the mild infection seems to have no effect on the health of the host. This general mild infection makes any anti-ankylostoma campaign quite hopeless in this country for many years to come. Severe cases do, of course, occur, but, speaking generally, we hear little of them. Their relative distribution in different parts of India is unknown. Our knowledge of ankylostomes in India is quite meager, in spite of the amount of work which has been done by I. M. S. officers, and much of the work will have to be done over again.

Apparently, hookworm infection, while common in India—at least among the laboring classes—is in the great majority of cases extremely light and can not be supposed to exert any noticeable effect upon health and development. To ascribe the racial inferiority of the inhabitants of India, therefore, to such infection seems entirely unwarranted from the data at hand.

Thus, the question of Dr. Wherry, "Is there any evidence whatever that a low protein diet ever causes or aids in the production of racial inferiority," is in precisely the same status now as it was before his article appeared. In fact, however much one may disagree with the interpretation that McCay puts upon his own data, the unprejudiced must admit that the data are extremely suggestive of a deleterious effect of long-continued adherence to the low-protein dietary. However much one may be-

lieve that the low physical development and efficiency of the native races of India as compared with the Eurasian or the European in the same country and under the same conditions, are due to unsuitable food materials, insufficient diet during the period of growth, or to any other factor than the low-protein intakes of the adult population, the possibility that the latter is a contributory factor at least can not be denied, nor can it even be supposed to be very improbable.

H. H. Mitchell

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The Spirit of Agricultural Education

The recent communication to Science for May 9 by Dr. Raymond Pearl, and the discussion thereon in Science of June 13, by Dr. Davenport, causes one to surmise there are at least two opinions in the United States relative to research in experiment stations.

Dr. Pearl apparently deplored the seeming fact that experiment station workers must "supplicate the great Goddess Truth with one ear closely applied to the ground in order that he must catch the first and faintest murmur of 'What the public wants.'" He did not say "the public be damned" and perhaps he did not mean to. He did, however, give at least one reader the impression that he has small faith in farmers as patrons of experiment-station work. He apparently did not council experiment station workers to make an effort to adapt their results to the understanding and needs of "uncritical farmers." He would seem to think that this genus farmer, true to type as he is, had better be taught to look "through a glass darkly."

If agricultural experiment stations were established for any particular purpose toward our civilization, it was and is to serve the needs of farming people. It is a part of their job to adapt themselves and their work to the needs of such people. If they will do that very genuinely and sincerely, they will find these same people appreciative. If in any such instance they do not respond so quickly as they should, the greater is the obligation upon the experiment station and its associated college to help them. Who does the work, anyway, which supports these various experiment stations, from the favored state of Maine to the other ocean?

These paragraphs are not written solely to disagree with so evidently an illustrious worshiper of the "great goddess Truth" with his "ear to the ground." Such would hardly be worth while. But it has virtually been charged in public print, by a reputable member of an experiment station staff, that much work and many workers of experiment stations are insincere. Such a charge, insidious as it is, does most insidious damage—undemocratic as it is in spirit, it would lead logically to the discrediting of our experiment stations as unworthy of support in a democracy.

If there is anything the matter with the land-grant colleges and experiment stations, it is that they have occasionally loaded upon them such pseudo-scientific junk as Dr. Pearl might apparently like to have our "uncritical farmers" unwittingly support. It is a mighty serious matter that if any of our land-grant institutions fail of popular support it will be because they fall victims to pseudo-science.

By pseudo-science I mean that so-called pure scientist who does his work or holds his job (and draws his salary) under the name of agriculture, with contempt in his heart for real farm people. Just such codfish aristocracy has failed visibly to accomplish much for the peasant farmers of Germany. However erudite it may be, it will fail of accomplishing much for American farmer citizens, as such.

Right now the land-grant colleges and experiment stations are on trial to show what real service they are capable of rendering to our farm citizenship. It is within their power to make a most conspicuous success.

If our American agricultural institutions should continue to organize themselves around pseudo-scientific units—*e. g.*, agricultural chemistry, agricultural botany, agricultural economics, agricultural what-not, or any old

thing to give some old-school aristocrat a job of foisting some mighty poor science and poorer agriculture upon farmers, then they will deserve to go down with those they fail to minister unto.

If our American land-grant colleges and experiment stations shall faithfully and fearlessly disregard old, artificial precedents, and organize themselves around agricultural units, it will be they who preserve the intellectuality of our great body of farmer citizenship. Will they do it? is the question to-day in the mind of the "uncritical farmer." This same farmer has time and again since the battle of Lexington shown his willingness to bear the burden of any real and sincere educational need.

And now, if any pure scientist delights not in agriculture, and in the problems of the farm, he should draw his salary from some more congenial source. It is the function of pure science to increase the sum of human knowledge. Let her worshipers be about their high calling.

It is the function of the experiment stations to apply themselves to the solution of the problems of agriculture. Such work this hour demands not only the finest skill and cleverness, but the most searching integrity. Such is real worship of the "great Goddess Truth."

The very insincere practise of trying to deceive their constituency, which Dr. Pearl seems to cite, as the only recourse for doing scientific work in experiment stations, is that which could result in the prostitution of all science, and which might result in the degeneration of American agriculture.

A. N. HUME
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THE TARIFF ON BOOKS

TO THE EDITOR OF SCIENCE: As most of us probably think of the new tariff law as one that reduces duties, it may be well to call the attention of readers of SCIENCE to one or two items of increase that are of interest.

Books in foreign languages *are no longer* to be on the free list, and books over twenty years old must *also have been bound over twenty years* to be entitled to free entry.

As most German books are bound after publication, and there is no telling when, this might be a serious impediment to easy ordering of books from second-hand catalogues.

As a revenue measure will it yield enough to pay for the delay and obstruction to the *free* circulation of knowledge involved? This is not a bit of the "New Freedom," I trust.

ALFRED C. LANE

SCIENTIFIC BOOKS

Catalogue of the Mammals of Western Europe (Europe exclusive of Russia) in the collection of the British Museum. By GERRIT S. MILLER. London. Printed by order of the Trustees of the British Museum. Sold by Longmans, Green & Co., 39 Paternoster Row, S. C.; B. Quaritsch, 11 Grafton Street, New Bond Street, W.; Dulau & Co., Ltd., 37 Soho Square, W., and at the British Museum (Natural History), Cromwell Road, S. W. 1912. All rights reserved. 8vo. Pp. 15 + 1019; 213 text figures.

Mr. Miller's "Catalogue of the Mammals of Western Europe" supplies a long-needed authoritative manual of the mammal fauna of Europe. It includes, however, only the land mammals, it excluding the seals and cetaceans. The Gibraltar macaque and the Indian buffalo are omitted as being artificially introduced species. Geographically it is restricted to continental Europe outside the Russian frontier and the immediately adjoining islands, but includes also Spitzbergen, Iceland and the Azores.

The preface, by Dr. Sidney F. Harmer, keeper of zoology at the British Museum, states that a work of this nature "was many years ago suggested by the late Lord Lilford, who kindly contributed an annual sum towards the collecting necessary for its realization," but "the possibility of issuing the present catalogue has mainly grown from the work which its author, Mr. Gerrit S. Miller, of the United States National Museum at Washington, has for some years been doing independently on the subject." Through the

Lilford Fund and contributions by Major G. E. H. Barrett-Hamilton, who has published many papers on European mammals, and by Mr. Oldfield Thomas, curator of mammals at the British Museum, material for the work slowly accumulated, but its preparation was not begun till 1905, when, as Dr. Harmer states, "Mr. Miller arranged to devote his entire time for a considerable period to the study of European mammals. The opportunity was taken of having the results of this work published here instead of in America, by inducing him to write a British Museum Catalogue; thus utilizing his knowledge, and combining for the purposes of his studies the material of both the American and the British National Museums. Collections were then made in various selected areas, partly by Mr. Miller himself and partly by trained collectors . . . the cost of whose services were contributed by friends of the museum." Mr. Harmer adds: "The catalogue could hardly have been contemplated if it had not been for Mr. Thomas's unremitting efforts in developing the collection. He has not merely regarded these efforts as an official duty, but he has in addition been a generous donor who has frequently supplied funds for the purpose of obtaining specimens. Mr. Miller has thus had at his disposal a collection fairly representative of all parts of western Europe, and immensely superior to anything that had been thought of before he began work."

The author, in his introduction, goes into details in respect to the gathering of this material, with reference to its geographical sources, donors and collectors, and the museums, public and private, from which types and other important specimens were borrowed for examination. Altogether the number of specimens on which the work was based, it is stated, "approximates 11,500," of which about 5,000, including 124 types, are in the British Museum, about 4,000 in the United States National Museum, and the rest in various European collections. Nearly every section of the area embraced is represented by collections, more or less extensive and recently gathered, but not always sufficient for the task in hand, for the author states: "This material has been found sufficient, in most of the groups, to give what appears to be a fairly satisfactory idea of the essential features of the fauna. In the ungulates and the larger carnivores, however, it is so totally inadequate that no attempt could be made to revise the genera by which they are represented. This is especially to be regretted on account of the fact that some of these larger mammals are nearly extinct, while others are being modified by the introduction of foreign stock to replenish exhausted game preserves. Immediate action is necessary if the final opportunity to gain a clear understanding of this part of the European fauna is not to be lost."

The number of forms recognized is 314 (195 species[1] and 119 subspecies), referred to 69 genera. All are represented in the British Museum except 22, and all but 6 of those included were examined by the author. All questions of nomenclature have been decided by the rules of the International Code. The citations of the literature are "restricted to those which seem of importance in giving a clear idea of the systematic history of each animal"—to synonymy and original descriptions of the genera, species and subspecies, to the first use of the names adopted, to the "monographic works" of Blasius and Trouessart, and to such other publications as are pertinent to particular cases. Of the 213 text figures, representing skulls and teeth, nearly one half are original, drawn by Mr. A. J. Engel Terzi, of London; the others were loaned by the Smithsonian Institution and were drawn by Mr. H. B. Bradford.

As usual in similar monographs, keys are given for the families, genera and "forms" (species and subspecies). The descriptions of the species are detailed and comprehensive, and include external and cranial measurements. The cranial measurements are tabulated and often occupy a number of pages for a single species. The illustrations are restricted to the skull and teeth of each species, there being three outline views of the skull, all

[1] Only 30 per cent. of the species are represented by subspecies, 70 per cent. being monotypic.

natural size except when the skull is too large for full representation on the page, when it is shown reduced to a stated scale; the teeth of small species are represented in well-executed drawings, enlarged 5 to 10 diameters; those of large species are drawn natural size. Lists of "specimens examined" are given for each form, with their localities, and in addition a catalogue of those belonging to the British Museum.

It is to be regretted that the author found the literature of European mammals "so voluminous, particularly as regards local lists and special notes on distribution," and so difficult to correlate with our present "conceptions of species and local races," that he considered the labor of citing it in "extended bibliographical tables for each form recognized" would be "incommensurate with the importance of the results." The labor would have been undoubtedly very great, and the citations would have considerably increased the size of an already rather bulky volume, but it is work greatly to be desired, and also work that can be properly done only by an author having Mr. Miller's expert knowledge of the subject. The citation of the more important general works and papers relating to European mammals, however, would have been an aid to students desiring information additional to the technical descriptions of the present work.

As an illustration of the author's resources and method of treatment, the genus *Sciurus*, or the arboreal squirrels, may be cited. It may also serve as an illustration of the early slow and recent rapid development of European faunistic mammalogy.

The describing and cataloguing of the mammals of western Europe began long before the labors of Linné, but he was the first to give them modern systematic names. During the last half of the eighteenth century about a dozen different authors had described and named European mammals, so that by the end of that century nearly one half (90 out of 195) of the forms given in the present work as *full species* had been described and named. These comprise all the leading types, those added later being for the most part small or obscure forms, many of which would not have been given recognition in that early day even if they had been known. Of these eighteenth century species, Linné alone named two thirds, and three other authors (Schreber, Pallas, Erxleben) named two thirds of the remainder.

During the first 95 years of the nineteenth century (1800–1894) 56 species and subspecies were added by 34 authors. Up to 1895 the authorities for the names of species and subspecies, on the basis of Miller's nomenclature, number 50; but most of the post-Linnean genera and subgenera were founded by systematists whose names do not often occur as describers of the species and subspecies here referred to them.

In striking contrast with the record from 1758 to 1894 is the record for the next sixteen years (1895–1910), during which period 170 forms were first described, the work of 20 authors, of whom 8 described 133, 66 of which were described by the author of the present "Catalogue," 25 by Barrett-Hamilton, and 10 each by Cabrera and Thomas.[2] A comparison of the two periods—one covering a century and a quarter, the other sixteen years—on the basis of Miller's "Catalogue," shows that 55 per cent. of the now recognized species and subspecies have been described since 1894.

We now return to the illustration afforded by the genus *Sciurus*, represented in the "Catalogue" by a single species, divided into 12 "forms" or subspecies.

(*a*) *Method of Treatment.*—Following a page and a quarter devoted to the "characters" and geographical distribution of the family Sciuridæ, including a key to the European genera, the treatment of *Sciurus* occupies 26 pages (pp. 898–923). A half page, devoted to the synonymy, geographical distribution and characters of the genus, is followed by six pages on the species *Sciurus vulgaris* Linné, including (1) distribution, (2) diagnosis, (3) external characters, (4) color,

[2] Two additional species were described after 1910—one in 1911 and one in 1912. Also many others were described, by various authors, during the 1895–1910 period, which in the present work are relegated to synonymy.

(5) teeth, (6) illustrations (skull and teeth), and (7) key to the European forms. The synonymy is given only under the several subspecies, which are each diagnostically described, with measurements, a statement of its range, the sources and amount of material examined, and a list of the specimens contained in the British Museum. The descriptions of the subspecies occupy 14 pages, an average of a little more than a page to each, while the tables of cranial measurements fill four additional pages and include a total of 103 skulls, with 11 measurements of each skull.

(*b*) *Resources and Results.*—Although three of the here accepted subspecies of *Sciurus vulgaris* date from the eighteenth century, and two others from the early part of the nineteenth, none had become authoritatively recognized as tenable forms prior to 1896,[3] so that of the twelve forms now admitted six have been described and five others established since 1904. All but three of the 12 recognized forms are represented by fair series of specimens (5 to 174), the material examined aggregating 512 specimens. A list of the accepted forms, with their ranges and the number of specimens of each examined, here follows:

1. *Sciurus vulgaris vulgaris* Linné, 1758. Scandinavian Peninsula, except extreme north. Specimens examined, 53.
2. *Sciurus vulgaris varius* Gmelin, 1789. Extreme north of Scandinavian Peninsula, east into Russia. Spec. ex., 8.
3. *Sciurus vulgaris leucurous* Kerr, 1792. British Islands. Spec. ex., 174.
4. *Sciurus vulgaris russus* Miller, 1907. West-central Europe. Spec. ex., 26.
5. *Sciurus vulgaris fuscoater* Altum, 1876. East-central Europe. Spec. ex., 170.
6. *Sciurus vulgaris italicus* Bonaparte, 1838. Italy. Spec. ex., 38.
7. *Sciurus vulgaris lilæus* Miller, 1907. Greece. Spec. ex., 3.
8. *Sciurus vulgaris alpinus* Desmarest, 1822. Pyrenees. Spec. ex., 2.
9. *Sciurus vulgaris numantius* Miller, 1907. North-central Spain. Spec. ex., 22.
10. *Sciurus vulgaris infuscatus* Cabrera. Central Spain. Spec. ex., 5.
11. *Sciurus vulgaris segurœ* Miller, 1907. Southwest Spain. Spec. ex., 11. (Probably same as the next.)
12. *Sciurus vulgaris bœticus* Cabrera. Southern Spain. Spec. ex., 0.

[3] Nearly a dozen others of early date, proposed as "varieties," have never had currency, and are treated by Miller as untenable.

In general method and in details of treatment the "Catalogue" may well serve as a guide and an inspiration in similar undertakings. It furnishes for the first time a solid and orderly foundation for further systematic work on the mammal fauna of the area treated. Although the author's conclusions can not safely be challenged except on the basis of equal or better opportunities for investigation, doubtless some forms have been accepted that further study will show are not well founded, while others probably remain to be discovered. Finally, it is pleasant to contemplate the combination of circumstances that led to the preparation and publication of the work through a combination of the resources of two great national museums, and by an author so eminently fitted for the task.

J. A. Allen

Malaria, Cause and Control. By William B. Herms. New York, The Macmillan Company. 1913. Pp. xi + 163.

The purpose of this little work is to awaken the public interest in the control of malaria through the control of mosquitoes. Its appearance at this time is opportune, as, no doubt due to the example and influence of Celli in Italy, there has been a growing sentiment in many quarters in favor of the control of malaria by the extensive administration of quinine. Quinine control has not only proved impracticable under many circumstances, but under rigorous tests—particularly in the tropics—has even failed altogether. Professor Herms's book is based upon California experience and addresses itself directly to Californians; but in so far as similar conditions obtain elsewhere, it should have a much wider field of usefulness. The treatment is elementary throughout. A large part is devoted to the practical side of mosquito control.

The opening chapter, Economic Considerations, sets forth the direct and indirect losses occasioned by malaria and gives a concrete case to illustrate how serious these may be to a small community. It is shown that in a town of 4,000 inhabitants, in the northern Sacramento Valley, the expense and loss incurred during 1911, leaving out of consideration the resultant depreciation of real estate, amounted to about $75,000. In the itemized account it is shown that this community in combating malaria during 1911 spent $972.50 for quinine and $1,800 for patent medicines. The latter item is particularly striking when one considers that quinine is the only specific for malaria and that such medicines usually contain little or no quinine. They are therefore simply an additional drain upon the malarial victims. The author, basing upon experience elsewhere, states that effective mosquito-control work would cost this community about $2,000 a season and that the result would be the reduction of malaria by at least 50 per cent. the first year and 80 per cent. in the second year. The figures show strikingly how well mosquito-control work pays in a malarious region.

In the chapter, Malaria and its Transmission, the complex life history of the malarial parasites is explained in the simplest possible language, although not altogether satisfactorily. The author seems unaware that the pigment spots of the malarial parasites are the products of the ingested hæmoglobin. The following statement is surely an inversion of cause and effect, both the enlargement of the blood corpuscles and the anæmia being directly brought about by the parasites: "Enlarged parasitized corpuscles occur in this species [*Plasmodium præcox*], but merely as a coincident, since enlarged corpuscles commonly occur in anæmia, and these may be entered by the sporozoits" (p. 21). On page 28 the question is again brought up, and favored, whether there are reservoir hosts other than man for the asexual phases of the parasites. This needlessly obscures the subject, as there is a wealth of evidence to controvert such a belief and it is dismissed by all careful students.

The two chapters Mosquitoes in General and Anopheline or Malaria Mosquitoes show a fragmentary knowledge which the author might easily have remedied by a little careful reading in the works cited in his brief bibliography. On page 31 the statement is made that "the Culicidæ are distinguished from all other Nematoceran Diptera by the presence of scales on the wings and body." Such scales, however, occur in the Psychodidæ and in certain Tipulidæ and Chironomidæ. On page 33 the Culicidæ are said to divide into two subfamilies, the Anophelinæ with the palpi long in both sexes, and the Culicinæ with the palpi long in the male and short in the female. Aside from the fact that the relative length of the palpi is now discarded as a primary character by most students, there exist a considerable number of species with the palpi short in both sexes (Ædinæ of the older authors) and still others which must be looked upon as intermediate. The statement that "the males of all species of mosquitoes, as far as known, are provided with plumose antennæ" is far from correct. The statement (p. 42) that in all "culicine" (as against "anopheline") mosquitoes "except *Stegomyia calopus* the eggs are placed on end, forming a boat-shaped pack or raft," shows that the author is unaware of the considerable progress made within the last ten years in the knowledge of mosquito biology. The statement, too, that single mosquitoes may lay 750 eggs is contrary to the experience of many reliable observers. On the other hand, it is gratifying to find the author contending against the common idea that mosquitoes fly considerable distances. He rightly states that as a rule mosquitoes do not fly far and that the salt-marsh species are an exception in this respect. The chapters which follow deal with mosquito control. The importance of locating actual breeding-places is emphasized. The value of different control measures is discussed, the permanent abolition of breeding-places being held out as the ideal. An insight is given into practical work by a brief account of the local campaigns with which the author has been connected. The book should be useful in

convincing the uninformed that malaria-control through the control of mosquitoes is not only possible, but that it pays. While the inaccuracies do not materially detract from the practical value of the book, it is to be hoped that in the interest of truth they will be corrected in a future edition.

Frederick Knab
Bureau of Entomology

SPECIAL ARTICLES

THE ORIENTAL CYCADS IN THE FIELD

Cycads in the field, cycads in the botanical garden and cycads in the greenhouse, are so different that descriptions based upon plants growing in the garden should be checked by observations in the field, and accounts based upon greenhouse material must be viewed with great suspicion.

In the field, *Cycas circinalis* is said to produce a crown of leaves every year, and under ordinary greenhouse conditions, new crowns are usually produced every year; but where the heat is extreme and the rainfall excessive, two crowns each year may be produced for many years in succession. *Dioon* at Kew surpasses anything I have ever seen at Chavarrillo, but if the Kew specimens should be exposed to the blazing sun of the Mexican tropics, their magnificent crowns would probably wither in a few days. In cycad seedlings at the University of Chicago, scale leaves, which in the field would never have been anything but scale leaves, quite regularly develop into foliage leaves. The cycads, like roses, pinks and chrysanthemums, may appear to better advantage on account of greenhouse conditions, but for phylogenetic studies, their value is doubtful.

During the past year it was my privilege to study in the field the five oriental genera of cycads. Two of these genera are found only in South Africa, two only in Australia, and the remaining genus, *Cycas*, extends from Japan to Australia and Madagascar. Thus all the oriental cycads, except *Cycas*, are confined to the southern hemisphere; while all the western cycads, except *Zamia*, are confined to the northern. No genus is common to the east and the west.

The three genera found in Australia are *Cycas*, *Bowenia* and *Macrozamia*. All three are abundant in Queensland, the northeast part of Australia, and *Cycas* and *Bowenia* may be confined to this region; *Macrozamia* extends into New South Wales and is represented by at least one species on the western coast.

Cycas, in Australia, is represented by five species, only one of which, *Cycas media*, was studied in the field. The other three were seen in gardens. *Cycas media* was studied at Rockhampton, on the Tropic of Capricorn, and at Freshwater, in the Cairns district, about 700 miles farther north.

Eichler's account, in Engler and Prantl's "Die Natürlichen Pflanzenfamilien," gives *Cycas media* a height of 20 meters, making it the tallest of the cycads. This is undoubtedly a mistake. Dr. F. M. Bailey, in his "Flora of Queensland," states that the species reaches a height of 8 to 10 feet (2.4 to 3.05 meters) and sometimes twice that height. Mr. Simmons, director of the Botanical Garden at Rockhampton, and Mr. Anderson, director of the Botanical Garden at Townsville, assured me that the plant seldom exceeds 3 meters in height and that specimens 6 meters in height were extremely rare. Mr. Sydney Snell, who for many years has lived and hunted in the Berserker Ranges near Rockhampton, showed me the tallest specimen he had seen, and it measured about 6 meters. I received similar reports all the way from the southern to the northern limit of the species. At Freshwater, in the Cairns district, I found one plant which was 7.01 meters in height. The mistake in Eichler's account probably arose in mistaking feet for meters.

A section of the trunk shows the polyxylic condition, but a specimen 2 meters high shows only two or three zones of wood, while a specimen of *Cycas revoluta* half a meter in height might show as many as three or four.

The trunk is ribbed, like that of *Dioon spinulosum*, and the ribs are due to the alternation of foliage leaves and scale leaves or

sporophylls. The ovules have a bright orange color.

The taxonomic descriptions of the four Australian species of *Cycas* are very incomplete, but may be sufficient for identification. All the species grow in the omnipresent but scanty eucalyptus bush, often associated with *Xanthorhiza, Pandanus* and *Macrozamia.*

Material has been secured for a complete morphological study, including the anatomy of the adult plant and the seedling.

The most peculiar of the Australian cycads is *Bowenia,* whose bipinnate leaves readily distinguish it from all other cycads. There are two species, *Bowenia spectabilis,* which is abundant in the northern part of Queensland, about Cooktown, Cairns and Innesfail; and *B. serrulata,* which is at its best in the neighborhood of Rockhampton, about 700 miles south of Cairns. The range of the species could not be determined, but from the reports of directors of botanical gardens, amateur botanists and others, there seems to be a considerable region between the Rockhampton and Cairns districts, where neither species has been found. *Bowenia spectabilis* has only a few leaves, but they have a deep green color and retain their beauty long after they have been cut from the plant. *Bowenia serrulata* has a much greater display of foliage and, in some places, is so abundant that it forms a dense, but easily penetrated underbrush.

The stems of both species are subterranean, so that one of the most striking differences between them might be overlooked. The stem of *B. spectabilis* is elongated and fusiform, while that of *B. serrulata* is nearly spherical. In both, the leaves are borne on branches from the top of the stem.

Macrozamia, with more than a dozen species, is the dominant genus, and it ranges from the northern part of Queensland to the southern limit cycads in New South Wales, and has at least one species in western Australia.

Most of the species have tuberous, subterranean stems. Among these species, *M. spiralis* is probably the most abundant and widely distributed. It is generally believed that species in cycads are rather fixed, but a study of this species and associated species would soon convince one that there is great variation and, perhaps, mutation. Some of the species, like *M. Miquelii,* closely resemble *M. spiralis;* while others, like *M. heteromera,* bear less resemblance; but nevertheless, specimens of these two species could be selected which so closely resemble each other, that some call them both *M. spiralis.*

M. corallipes, M. Fawcetti and *M. Paulo-Guilelmi* rather closely resemble *M. spiralis.* A field study of several species warrants the suggestion that *M. spiralis* is the source from which the rest of the tuberous species have been derived.

There are only three species with tall, cylindrical trunks, and these are so distinct that they are easily recognized at a glance. All three species are found in Queensland—*M. Denisoni,* on Tambourine Mountain near Brisbane, is regarded by Eichler as the most beautiful species of the genus. The ovulate cones are nearly a meter long and reach a weight of 35 kilos. The seeds are so large that they are used as match boxes. *Macrozamia Moorei,* almost on the Tropic of Capricorn, at Springsure, is of more than ordinary interest on account of its close resemblance to the Mesozoic Bennettitales. Unfortunately, the leaves of this species, like those of most cycads, contain a poison which is very disastrous to cattle; consequently, cattlemen are trying to exterminate the plant, and are succeeding so well—or, from another standpoint, so badly—that in a few years it may be impossible to get a specimen for a conservatory. They poison the plant by chopping a notch and injecting arsenic into the pith.

Macrozamia Hopei, in the Cairns district, is the tallest of all cycads. I did not see it, except in cultivation, but Dr. F. M. Bailey told me that the statement in his "Flora of Queensland" that the species reaches a height of 60 feet (about 18 meters) is based upon reliable information.

Material, photographs and notes for an extended study of all the Australian genera and most of the species have already been secured,

and collections to make the life history studies more complete are being forwarded to Sydney, where they are cared for by Professor Maiden. This work will be continued by my friend, Professor A. A. Lawson.

The two African genera, *Stangeria* and *Encephalartos,* are confined to a narrow strip along the southeastern coast, and throughout most of the range the two genera are associated.

Stangeria is quite fern-like in appearance and was described as a species of *Lomaria* before the cones were discovered. There is probably only one species, *S. paradoxa,* although several attempts have been made to make more species. A species maker, unfamiliar with *Stangeria* in the field, could easily be tempted by carefully selected plants, or even by different leaves from the same plant, for leaves vary from entire to serrate, and sometimes the serrations are so deep that the leaf becomes almost bipinnate. We all know what gardeners can do with ferns of the *Nephrolepis* type.

Stangeria is most abundant on the open grass velt, where it grows in dense grass as tall as the plant itself. It also grows in the shade in the bush velt, and here it becomes much taller than in exposed situations. Were it not for the obvious relation between the grass velt and bush velt forms, one might describe them as distinct species.

Stangeria in the field, with one, two or three leaves, and only rarely with five or six, presents a striking contrast to the cultivated plant, with its abundant foliage.

My own collections, supplemented by collections made in Zululand by Professor W. C. Worsdell, and in the Transvaal by Professor W. T. Saxton, and particularly by collections made near Kentani by Miss Sarah van Rooyen, have made the series for morphological study very complete.

Encephalartos, with about a dozen species, is the dominant genus. I was able to study nine species in the field and saw the rest in botanical gardens. The various species may be placed in three fairly definite groups, one with the stems tuberous and subterranean or extending slightly above the surface; and the other two with stout cylindrical trunks.

Encephalartos villosus, the most familiar species in cultivation, is a type of the tuberous group. It grows in the shade, has a wide range, and at various places is associated with species of the other two groups. *E. brachyphyllus* in Zululand is an interesting but little-known member of this tuberous group. Still less is known of *E. cycadifolius,* which I saw in the field only at East London. The ovulate cone is quite characteristic, but is clearly of the *E. villosus* type. *E. Hildebrandtii,* quite familiar in cultivation, does not occur as far south as Zululand, and, consequently, I did not see it in the field, but it certainly belongs to the *E. villosus* group.

E. caffer may be taken as the type of one of the two groups with cylindrical stems. It is abundant at Van Staadens, near Port Elizabeth, where it grows in the sun, on rocky mountain sides. The ovulate cones are the largest ever reported for any gymnosperm, sometimes reaching a weight of 90 pounds (45 kilos).

A nearly related species, *E. Altensteinii,* quite common in cultivation, was studied at various places from Zululand to East London. This species looks so much like *E. caffer* that the labels in botanical gardens are not always convincing, and local botanists assured me that they could always select leaves from *E. Altensteinii,* which taxonomists, at a distance, would identify as *E. caffer.* Some confusion may have crept into the literature through such practical jokes. A young plant of *E. Altensteinii*—and a plant 100 years old might be called young—could hardly be mistaken for *E. caffer;* but an old plant is sure to make trouble, if one is trying to identify it with a manual. A fine specimen of *Encephalartos* in the Botanical Garden at Melbourne, Australia, bore no label, and the director informed me that he had removed the label, placed there about fifty years before by Baron von Müller, who had identified the plant as *E. Altensteinii,* because the specimen did not agree with that description. A couple of young leaves, doubtless due to a wound at the base

of the trunk, showed typical *E. Altensteinii* characters. In Baron von Müller's time the plant probably agreed with the taxonomic description, which was certainly based upon a young plant. No plant of *E. Altensteinii* with a trunk more than three meters high is likely to agree with the taxonomic diagnosis.

The big cones, as in most of the species, have seeds with a brilliant red seed coat.

The remaining section, which might be called the *horridus* section, on account of its forbidding leaves, comprises four species, all confined to the southern part of the cycad range.

Encephalartos Frederici Guilelmi occurs in greatest abundance at Queenstown and Cathcart. It has a majestic trunk and a fine crown of glaucous leaves. The leaflets are pungently pointed but the margins are not spiny, so that it is only by the numerous intergrades between this species and the next that it deserves a place in the *horridus* section. No other cycad has such a densely tomentose bud. The cones, sometimes five or six in number, are lateral and are arranged around a central bud.

Encephalartos Lehmannii is often confused with the preceding species, but has a broader leaflet, which may be entire, or spiny or may have big, coarse teeth like *E. horridus*. The staminate cones, which have a reddish color and are not very hairy, distinguish the species at a glance. The ovulate cones are equally characteristic, being very tomentose in *E. Frederici Guilelmi* and nearly smooth in *E. Lehmannii*.

The type of the section is *E. horridus*, whose jagged leaves, as sharp and rigid as if they had been cut out from sheets of tin, give this plant a clear title to its name. No cycad is more xerophytic and the various aloes, cotyledons and crassulas associated with it would make a fine study for an ecologist.

An almost unknown member of this section, which I saw only at Trapps Valley, in the vicinity of Grahamstown, is *E. latifrons*. It occurs in the open grass velt and the plants are widely separated from one another, half a mile or more apart. The leaflet is jagged, like that of *E. horridus*, but the trunks are stouter and the cones several times larger. The growth is even slower than in *Dioon edule*. Two plants, about one meter in height, on a lawn at Trapps Valley, have been under observation for nearly fifty years, and I was assured that they always bore leaves, sometimes new leaves, but that they were no taller than when first set out.

One object of the trip was to secure material for a complete morphological study of the five oriental genera. Through the generous cooperation of directors of botanical gardens and local botanists, this object was attained in far greater measure than I had dared to hope.

Even a morphologist should know his material in the field, and so I made careful observations and notes on all the species I could find. One result of the field study was not anticipated. From a field study of the Mexican genera, I had begun to regard the species of cycads as rather rigid. Of the four western genera, *Dioon, Ceratozamia* and *Micrōcycas* are monotypic or nearly so; *Zamia*, with its thirty or more species, would probably show considerable variation if one could study it from Florida to Chili. The *spiralis* section of *Macrozamia* in Australia and the three sections of *Encephalartos* in Africa show that some cycads are still plastic and show variations which may be fluctuating or which may be mutations. Unfortunately, most cycads do not produce cones until they are from twenty to fifty years of age, and, consequently, one could not begin experimental work with much prospect of seeing results.

CHARLES J. CHAMBERLAIN
UNIVERSITY OF CHICAGO

TWENTY-FIRST ANNUAL MEETING OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

THE regular annual meeting of the Society for the Promotion of Engineering Education was held in Minneapolis from June 24 to 26 inclusive. The principal sessions were held in the new Engineering Building of the University of Minnesota and in the West Hotel, the latter being a joint session with the American Water Works Association. A comprehensive series of papers was presented by

members and non-members covering many of the important phases of engineering education and allied matters. Several of these took tangible form in committees appointed to carry out the suggestions presented in the papers. For example, a paper by Professor E. V. Huntington, of Harvard University, on "The Units of Force" was partly instrumental in causing the appointment of a Committee on the Teaching of Mechanics to Engineering Students. In another paper Mr. D. M. Wright, of the Henry & Wright Mfg. Co., suggested the appointment of a committee to study and report upon the standardization of technical terms. This suggestion was carried out.

The presidential address of Professor Wm. T. Magruder, of The Ohio State University, was devoted to the qualifications required in a good instructor. He pictured an ideal instructor as one who knows his subject but is also in mental reach of his students; who has the highest reputation for honesty, right living, patience and sound character; who is in practical touch with the subjects he has to teach and who has unbounded enthusiasm for the work of both teacher and engineer.

Other important papers treated of the construction of buildings for technical schools, instruction in highway and in hydraulic engineering, in shopwork and in drawing. The general subject of academic efficiency was discussed by Professor H. S. Person, director of the Amos Tuck School of Dartmouth College. President A. C. Humphreys, of the Stevens Institute of Technology, and Professor G. F. Swain, of Harvard University, championed the four-year as against the courses requiring five years or longer, while the opposition was led by Professor F. H. Constant of the University of Minnesota. The results of the operation of the systematic grading system in use at the University of Missouri were described by Professor A. L. Hyde. Professor F. P. McKibben, of Lehigh University, called attention to the advantages of summer work for engineering students and explained how his students arrange for such work. A very interesting session was devoted to engineering college shop practise and engineering drawing. Professor J. V. Martenis and Mr. W. H. Richards described how shop work is made attractive and stimulating to the students by making the exercises lead to something definite. An extensive exhibit was used to illustrate the working out of the plan. Professor T. E. French, of The Ohio State University, a most successful teacher of engineering drawing, showed how this subject can be taught effectively. Among other papers one by Professors C. E. Sherman and R. K. Schlafly, of The Ohio State University, described a novel practise of sending civil engineering students into commercial work during the summer under the direction of instructors if the students could not obtain regular summer employment. Professor H. Wade Hibbard, of the University of Missouri, presented directions for thesis work and gave a long list of subjects suitable for investigation. Mr. Ivy L. Lee, executive assistant, the Pennsylvania R. R. Co., gave some excellent suggestions from the employers of technical graduates to the teachers, indicating how the latter can exert helpful influences in the right direction. These suggestions were well received and provoked considerable discussion. In addition to the papers there were committee and officers' reports, all of which showed the society to be in good condition and alive to its opportunities.

A number of social functions and excursions increased the pleasures of the meeting and enabled the members to meet the faculty of the University of Minnesota and their families and to appreciate the remarkable beauty of the country around Minneapolis.

The following members were elected to serve for one or more years in the positions indicated: *President,* G. C. Anthony, Tufts College, Mass. *Vice-presidents,* H. S. Jacoby, Ithaca, N. Y., and D. C. Humphreys, Lexington, Va. *Secretary,* H. H. Norris, Ithaca, N. Y. *Treasurer,* W. O. Wiley, New York, N. Y. *Councillors,* H. W. Tyler, Boston, Mass.; J. F. Hayford, Evanston, Ill.; A. S. Langsdorf, St. Louis, Mo.; S. M. Woodward, Iowa City, Iowa; M. S. Ketchum, Boulder, Colo.; F. P. Spalding, Columbia, Mo., and P. F. Walker, Lawrence, Kans.

President Magruder made the following important committee appointments, carrying out the instructions of the society: *Joint Committee on Engineering Education,* G. C. Anthony, A. N. Talbot; *Committee on Teaching Mechanics to Engineering Students,* E. R. Maurer (chairman), L. M. Hoskins, S. M. Woodward, C. E. Fuller, L. A. Martin, Jr., Wm. Kent, S. A. Moss, Albert Kingsbury, H. F. Moore; *Committee on Teaching Physics to Engineering Students,* D. C. Miller (chairman), G. V. Wendell, J. M. Jameson, W. S. Franklin, H. M. Raymond, O. M. Stewart, E. P. Hyde, G. A. Goodenough, F. K. Richtmyer; *Committee on Standardization of Technical Nomenclature,* J. J. Flather (chairman), W. D. Ennis, S. C. Earle, F. N. Raymond, D. M. Wright; *Committee on Statistics,* A. J. Wood (chairman), F. A. Barnes, F. A. Fish, J. D. Phillips, H. H. Stoek.